

Chapter 3 FRAPPY! Scoring Guidelines

Intent of the question The primary goals of this question are to assess a student's ability to: (1) describe the association in a scatterplot; (2) interpret the slope of a least-squares regression line; (3) calculate and interpret a residual; and (4) describe how an additional source of variation affects the value of r^2 .

Model Solution

- (a) There is a fairly strong, positive, linear relationship between sugar and freshness.
- (b) For each increase of 1 tablespoon of sugar, the predicted freshness increases by 15.8 hours.
- (c) With 2 tablespoons of sugar, the predicted freshness is $\hat{y} = 180.8 + 15.8(2) = 212.4$ hours. Thus, the residual $= y - \hat{y} = 204 - 212.4 = -8.4$ hours. This carnation stayed fresh for 8.4 hours less than expected based on the amount of sugar it received.
- (d) Because other flowers will probably stay fresh for a longer or shorter period than carnations, this will add an additional source of unaccounted-for variability in freshness. Because there will be less variation in freshness that is accounted for, the value of r^2 will decrease.

Scoring

Parts (a)–(d) are scored essentially correct (E), partially correct (P), or incorrect (I).

Part (a) is scored as follows

Essentially correct (E) if the response correctly addresses the direction, form, and strength of the association in context.

Partially correct (P) if the response correctly addresses 2 or 3 of the components (direction, form, strength, context).

Incorrect (I) otherwise.

Part (b) is scored as follows

Essentially correct (E) if the response describes the predicted (expected, average) change in freshness time for each increase of 1 tablespoon of sugar.

Partially correct (P) if the response makes exactly one of the following errors:

- doesn't mention "predicted" or equivalent
- reverses the roles of the two variables
- uses the wrong value for the slope
- doesn't specify that the predicted change in y is for each 1-unit increase in x
- doesn't answer in context

Incorrect (I) otherwise.

Part (c) is scored as follows

Essentially correct (E) if the response includes the following two components

1. Correct calculation of the residual with work shown
2. Correct interpretation of the calculated residual in context, including direction

Partially correct (P) if the response includes exactly one of the components above.

Incorrect (I) otherwise.

Notes:

- The minimal amount of work required is “ $204 - 212.4 = -8.4$.” Showing additional work should be considered good communication for the purposes of holistic scoring.
- If the response reverses the order of subtraction, then no credit is earned for the first component. The interpretation should be considered correct if it is consistent with the positive residual (actual is 8.4 hours longer than expected) or if correctly compares the actual and predicted values (actual is 8.4 hours less than expected).
- To be in context, the interpretation should include reference to the response variable (freshness) and correct units (hours).
- An interpretation that only says the actual value is 8.4 hours *from* the expected value does not correctly address direction

Part (d) is scored as follows

Essentially correct (E) if the response states that the value of r^2 will be lower than the first group's value and justifies the choice based on the increased variability in the response (freshness time).

Partially correct (P) if the response states that the value of r^2 will be lower than the first group's value and provides a weak justification regarding variability (e.g., only stating that there will be more variability without specifically addressing increased variability in the response variable).

Incorrect (I) otherwise.

Note: If the response argues that the value of r^2 will stay the same because other varieties of flowers will respond similarly to carnations (i.e., there won't be any additional variability in the response variable), the response should be scored essentially correct.

Each essentially correct (E) part counts as 1 point. Each partially correct (P) part counts as $\frac{1}{2}$ point. If a response is between two scores (for example, $2\frac{1}{2}$ points), use a holistic approach to decide whether to score up or down, depending on the overall strength of the response and communication.

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| 4 | Complete Response |
| 3 | Substantial Response |
| 2 | Developing Response |
| 1 | Minimal Response |